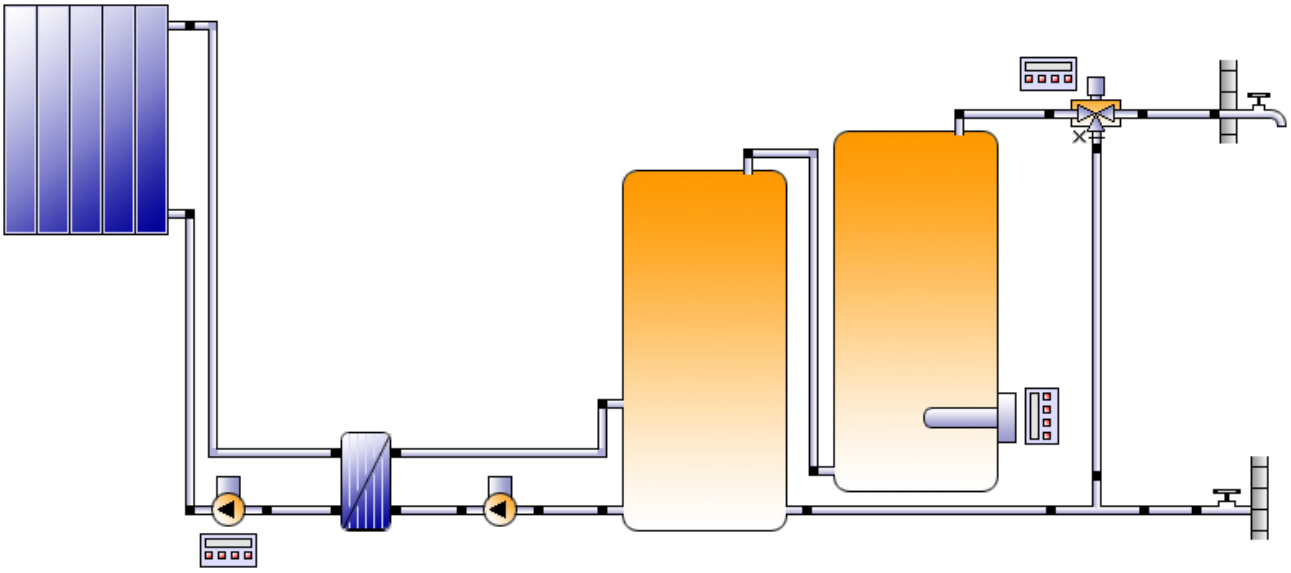
Professional Report

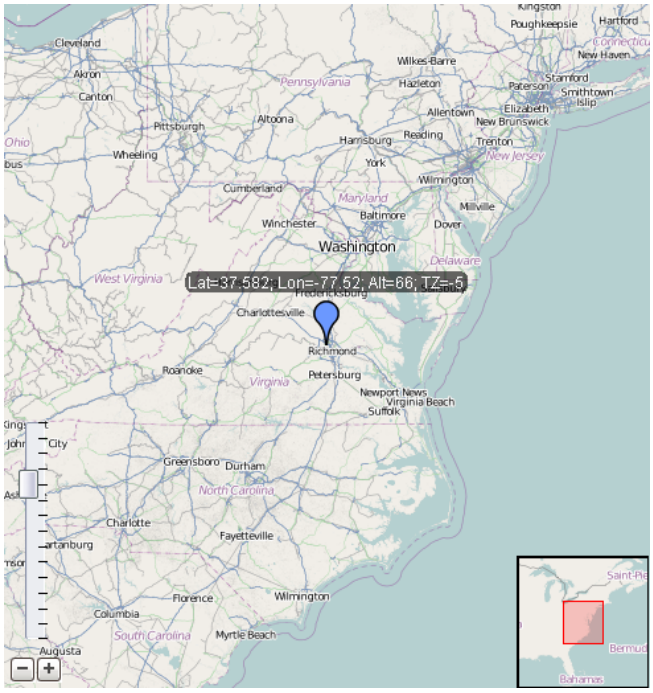
Closed-loop Solar System | **Closed-loop Solar Preheat with Back-Up Heater**



Location of the system

Richmond
Longitude: -77.52°
Latitude: 37.582°
Elevation: 217 ft

Map section



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System overview (annual values)

Total fuel and/or electrical energy consumption of the system [Etot]	87,390 kBtu
Total energy consumption [Quse]	240,704.7 kBtu
System performance (Quse / Etot)	2.75
Comfort demand	Energy demand covered

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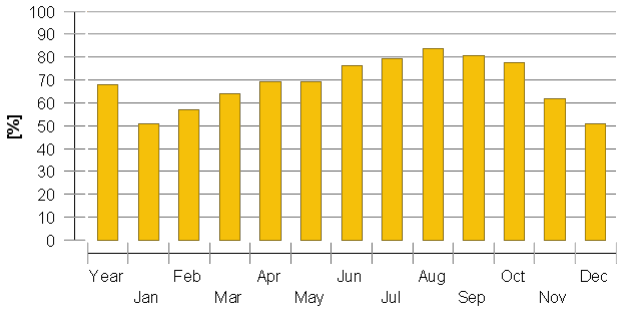
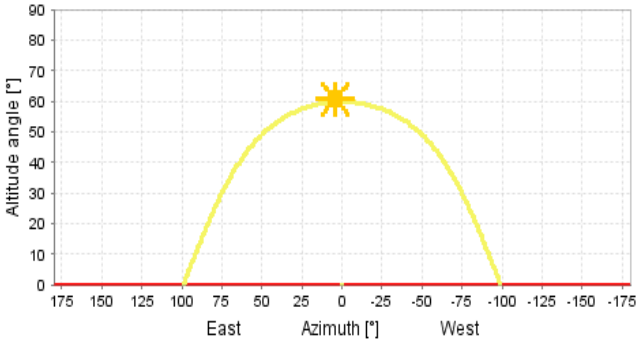
Overview solar thermal energy (annual values)

Collector area	798.7 ft²
Solar fraction total	67.7%
Total annual field yield	175,094.9 kBtu
Collector field yield relating to gross area	219.2 kBtu/ft²/Year
Collector field yield relating to aperture area	240.4 kBtu/ft²/Year
Max. fuel savings	1,785.7 therms: [Natural gas H]
Max. energy savings	182,390.5 kBtu
Max. reduction in CO_2 emissions	27,291.5 pound

Solar fraction: fraction of solar energy to system [SFn]



Horizon line



Meteorological data-Overview

Average outdoor temperature	58.3 °F
Global irradiation, annual sum	487.3 kBtu/ft²
Diffuse irradiation, annual sum	212.5 kBtu/ft²

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Component overview (annual values)

Collector North America	CR-140-A-P	
Data Source		SRCC
Number of collectors		20
Number of arrays		5
Total gross area	ft²	798.68
Total aperture area	ft²	728.286
Total absorber area	ft²	728.29
Tilt angle (hor.=0°, vert.=90°)	°	48
Orientation (E=+90°, S=0°, W=-90°)	°	0
Collector field yield [Qsol]	kBtu	175,094.9
Irradiation onto collector area [Esol]	kBtu	429,155.8
Collector efficiency [Qsol / Esol]	%	40.8
Direct irradiation after IAM	kBtu	220,665.8

Hot water demand	Constant	
Volume withdrawal/daily consumption	gal/d	1,851.7
Temperature setting	°F	120
Energy demand [Qdem]	kBtu	247,592.7

External heat exchanger	Watts/AOSmith 160kBtu/h	
Transfer capacity	W/K	3,953

Pump Solar Loop pump	Pump Eco, medium	
Circuit pressure drop	psi	1.966
Flow rate	gpm	14.6
Fuel and electrical energy consumption [Epar]	kBtu	168.2

Pump Solar Tank Pump	Pump Eco, medium	
Circuit pressure drop	psi	1.661
Flow rate	gpm	14.6
Fuel and electrical energy consumption [Epar]	kBtu	168.2

Storage tank Back-Up Heater	Cyclone BTH-300 Tank	
Volume	gal	130
Height	ft	5.25
Material		Enameled steel
Insulation		Flexible polyurethane foam
Thickness of insulation	in	2
Heat loss	kBtu	1,869.3
Connection losses	kBtu	804.5

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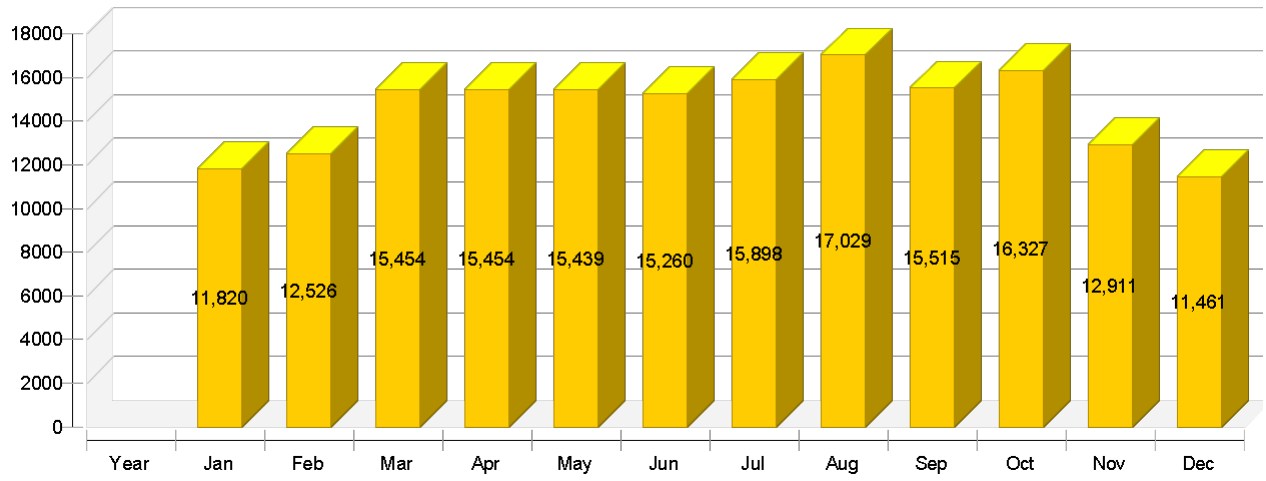
Storage tank Solar Preheat Tank	SJV-1000T	
Volume	gal	1,011
Height	ft	9.42
Material		Enameled steel
Insulation		Fibreglass and mineral wool matting
Thickness of insulation	in	3
Heat loss	kBtu	3,970.9
Connection losses	kBtu	773.2

Loop

Solar loop		
Fluid mixture		Propylene mixture
Fluid concentration	%	43
Fluid domains volume	gal	51.9
Pressure on top of the circuit	psi	10

Solar thermal energy to the system [Qsol] kBtu



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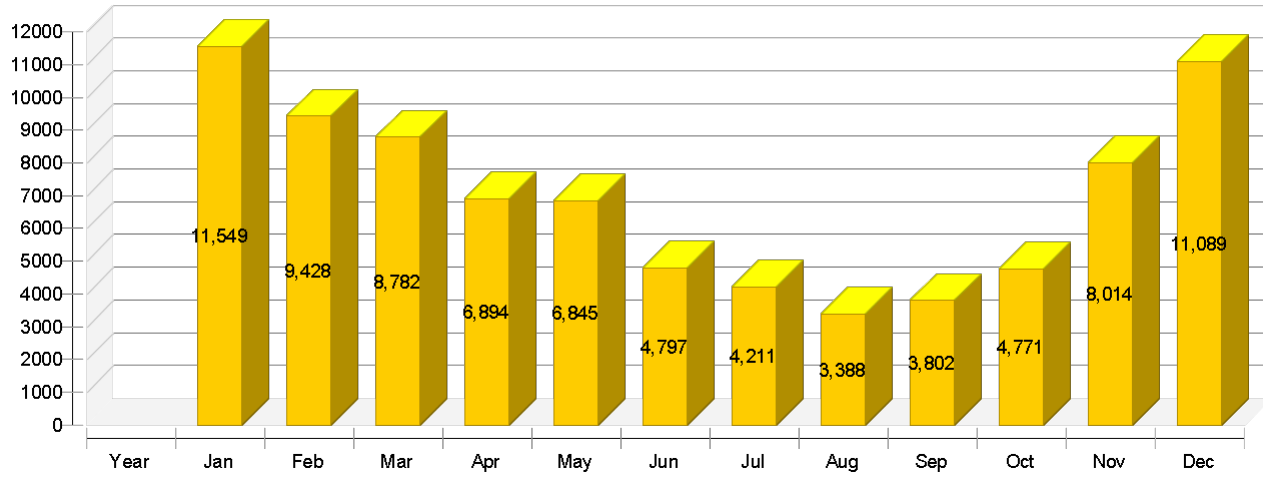
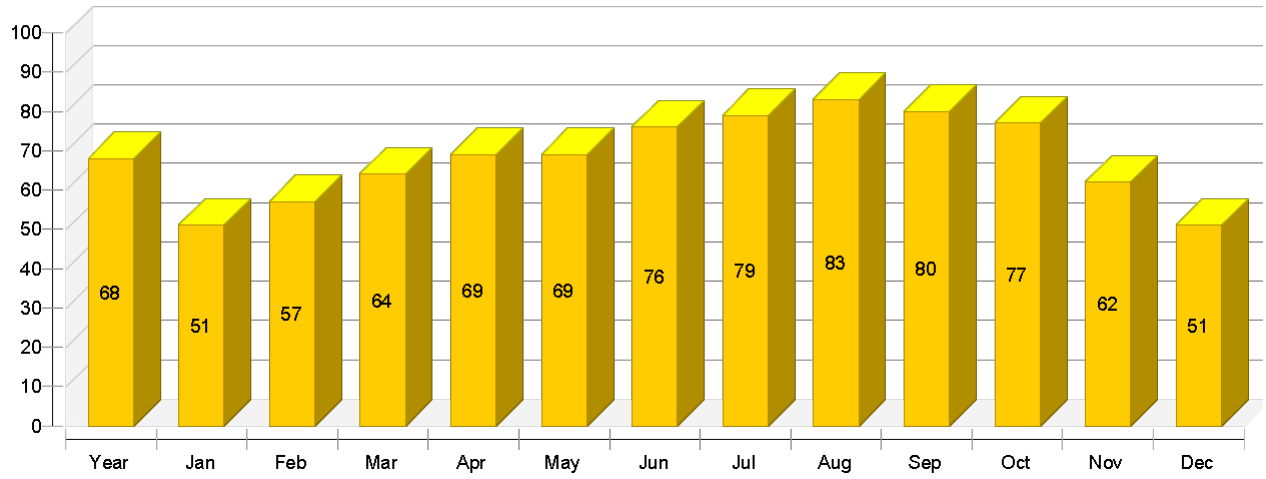
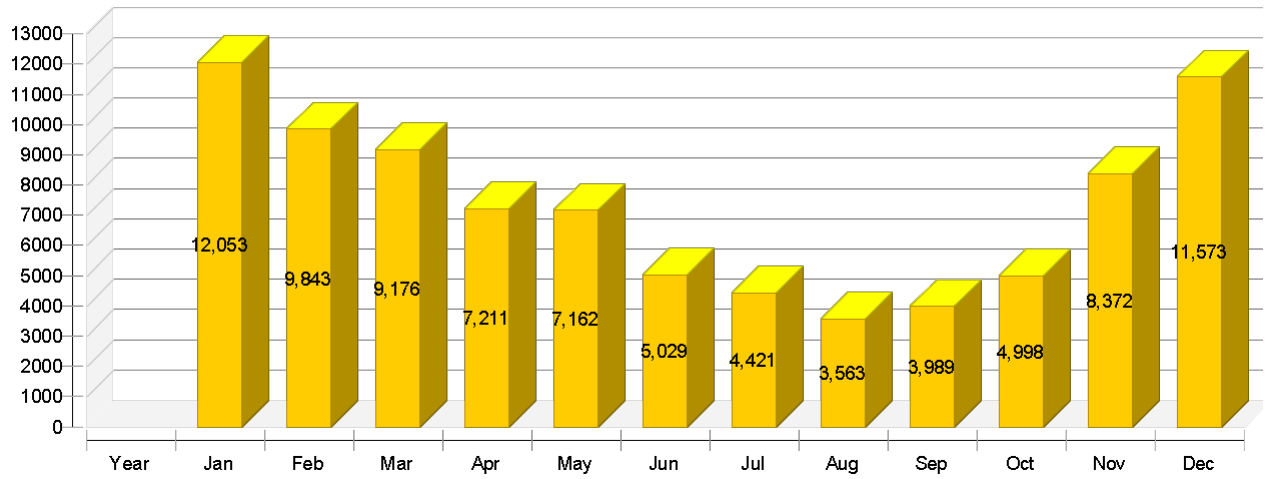
Heat generator energy to the system (solar thermal energy not included) [Qaux] kBtu



Solar fraction: fraction of solar energy to system [SFn] %



Total fuel and/or electrical energy consumption of the system [Etot] kBtu



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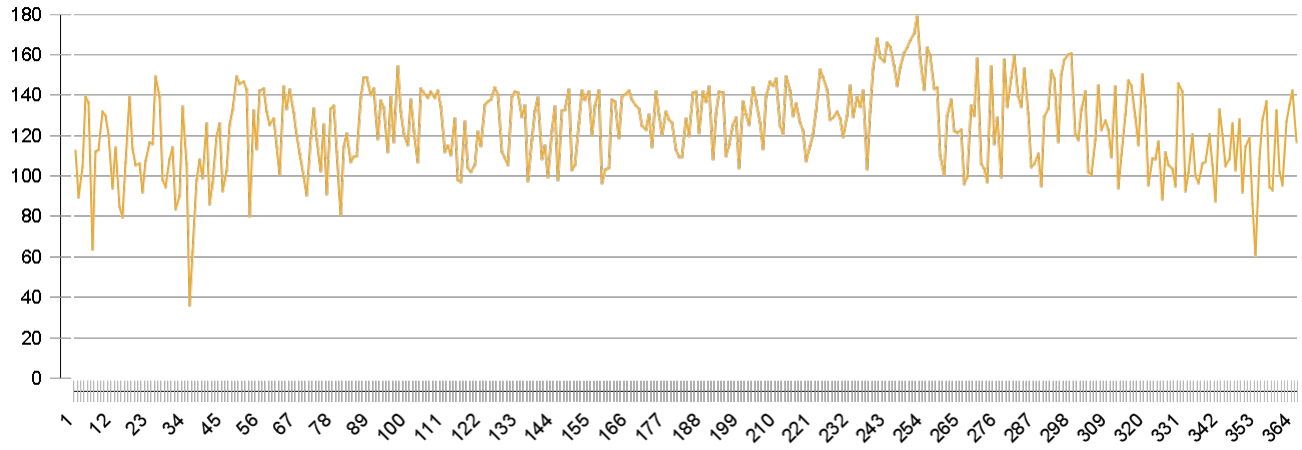
	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Solar thermal energy to the system [Qsol]													
kBtu	175095	11820	12526	15454	15454	15439	15260	15898	17029	15515	16327	12911	11461
Heat generator energy to the system (solar thermal energy not included) [Qaux]													
kBtu	83572	11549	9428	8782	6894	6845	4797	4211	3388	3802	4771	8014	11089
Heat generator fuel and electrical energy consumption [Eaux]													
kBtu	87054	12030	9821	9148	7181	7130	4997	4387	3529	3960	4970	8348	11551
Solar fraction: fraction of solar energy to system [SFn]													
%	67.7	50.6	57.1	63.8	69.2	69.3	76.1	79.1	83.4	80.3	77.4	61.7	50.8
Total fuel and/or electrical energy consumption of the system [Etot]													
kBtu	87390	12053	9843	9176	7211	7162	5029	4421	3563	3989	4998	8372	11573
Irradiation onto collector area [Esol]													
kBtu	429156	30561	31354	38578	38514	38637	37308	38238	39882	37530	39067	31184	28302
Electrical energy consumption of pumps [Epar]													
kBtu	336	22	22	28	30	32	32	35	34	29	28	24	22
Heat loss to indoor room (including heat generator losses) [Qint]													
kBtu	17084	1394	1263	1398	1371	1442	1383	1468	1525	1590	1501	1364	1385
Heat loss to surroundings (without collector losses) [Qext]													
kBtu	4697	410	388	447	404	364	320	321	373	421	458	397	394
Total energy consumption [Quse]													
kBtu	240705	22213	20547	22605	21109	20673	18651	18501	18249	18034	19348	19507	21267

Collector North America

Daily maximum temperature [°F]



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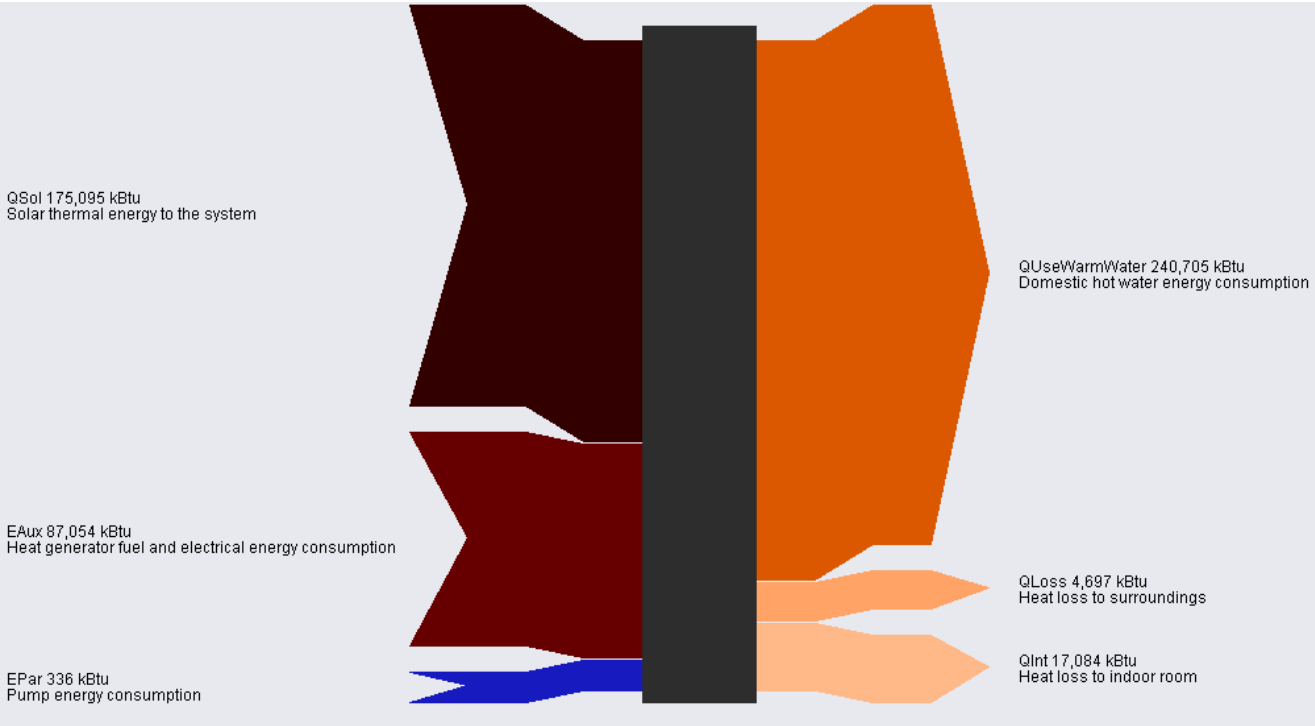
Energy flow diagram



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